Anomalous Production of Photon+Jets (+MET)
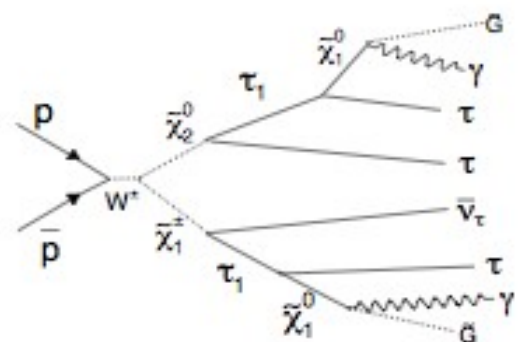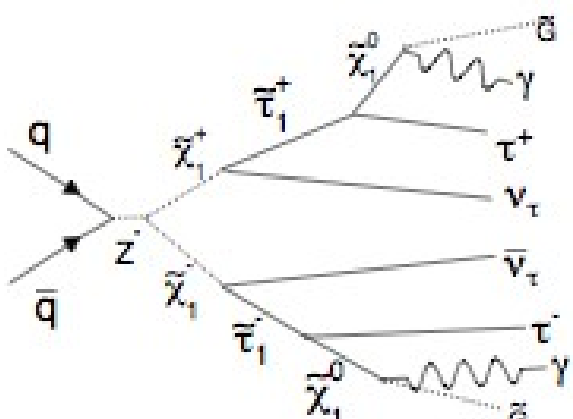
Samantha Hewamanage, Jay Dittmann, Nils Krumnack
Baylor University

Ray Culbertson, Sasha Pronko
Fermilab
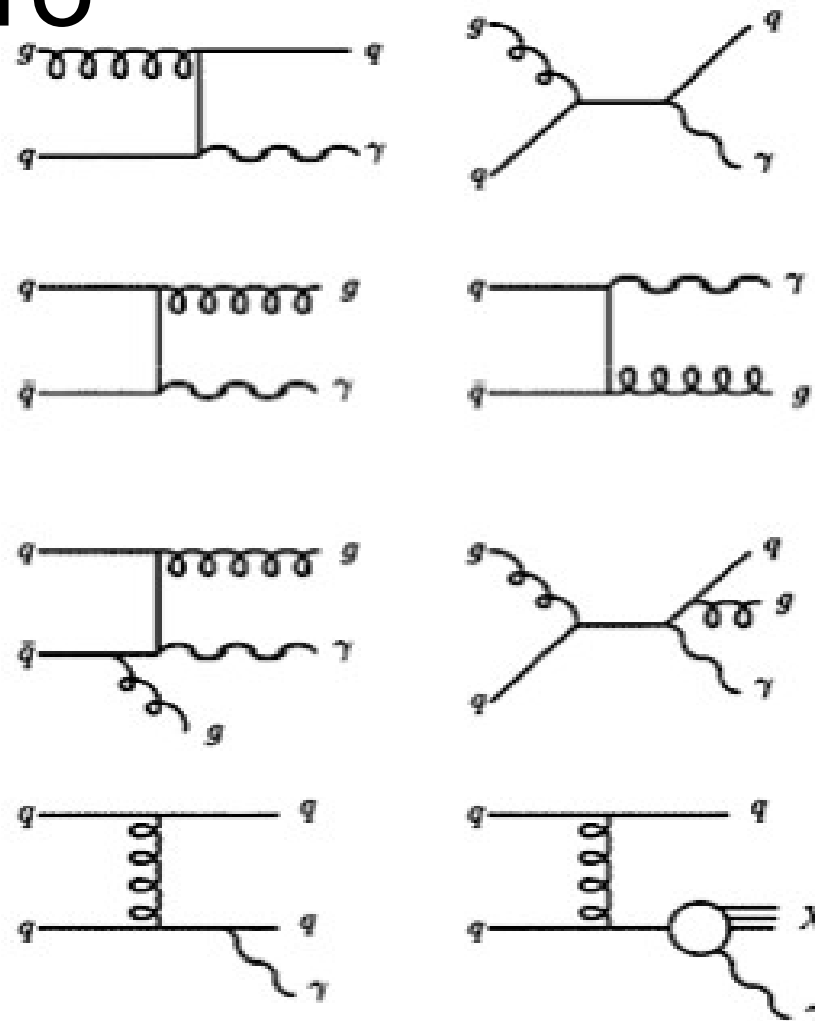
Outline

- Intro

- Triggers and Datasets

- Event, Photon, Jet and Signal Selection

- Backgrounds

- Results

Intro

SUSY GMSB processes for
Photon+Jet production
(source 8378)

SM- Tree level diagrams
for Photon+Jet production

Triggers and Datasets

- ## Triggers

  - ### PHOTON_25ISO, 50 and 70

- ## Datasets

  - ### cph10d,0h,0i,0j (up to p.13) Lum = 2.4 fb^{-1}

- ## Photon MC

  - ### QCD group, PYTHIA, Pt min 22 GeV, jqcdfh

- ## W/Z MC

  - ### EWK group, PYTHIA, W->e+nu (wewkfe, wewkge) & Z/gamma*-> e+e (zewk6d, zewkad)

Event Selection

- Require at least one of the three triggers
  - PHOTON_25ISO, 50 and 70
- must be in good run list (v19_pho)
- >=1 Class 12 vertices
- z < 60 cm
- Photon+>=1 Jet or Photon+>=2 Jets

Photon selection

Variable	Cut value
detector	central
E_T^{corr}	> 30 GeV
CES X and Z fiducial	$\lvert X_{CES} \rvert \leq 21$ cm 9 cm $\leq \lvert Z_{CES} \rvert \leq 230$ cm
Had/Em	$\leq 0.125 \; \lVert \; \leq 0.055 + 0.00045 \times E^{corr}$
$E_T^{Iso(corr)}$ in cone 0.4	$\leq 0.1 \times E_T^{corr}$ if $E_T^{corr} < 20$ GeV $\leq 2.0 + 0.02 \times (E_T^{corr} - 20)$ if $E_T^{corr} > 20$ GeV
average CES χ^2 (Strips+Wires)/2	≤ 20
N tracks in cluster (N3D)	≤ 1
Track p_T	$< 1 + 0.005 \times E_T^{corr}$
Track Iso(0.4)	$< 2.0 + 0.005 \times E_T^{corr}$
2nd CES cluster $E \times sin(theta)$ (both wire and strip E individually)	$\leq 0.14 \times E_T^{corr}$ if $E_T^{corr} < 18$ GeV $\leq 2.4 + 0.01 \times E_T^{corr}$ if $E_T^{corr} \geq 18$ GeV

Jet Selection

- Cone size =0.4, JetClu

- Remove identified EM objects

- Corrected up to level 6 (UE), particle jet.

- Require one or more jets with Et >15 GeV

- Can be in Central or plug (DetEta<3.0)

Selecting the Photon + Jets Signal

- a photon passing tight photon ID cuts

- in-time (> -4.8ns & <4.8ns)

- reject events with a trackless muon stubs in first 400 pb-1.

- reject photon and electron events

- reject di-photon events

- reject if beam halo

- 1 or more Jets

Backgrounds

- Non-collision
    - PMT spikes
    - Beam halo
    - Cosmics
- SM processes with MET, where e->gamma
    - largely from Ws.
    - smaller contributions from Zs, di-boson, tau ...
- QCD fake MET

All predictions are data based!

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Backgrounds:Non-collision: PMT spikes

+ Can reject 100% using PMT asymmetry.
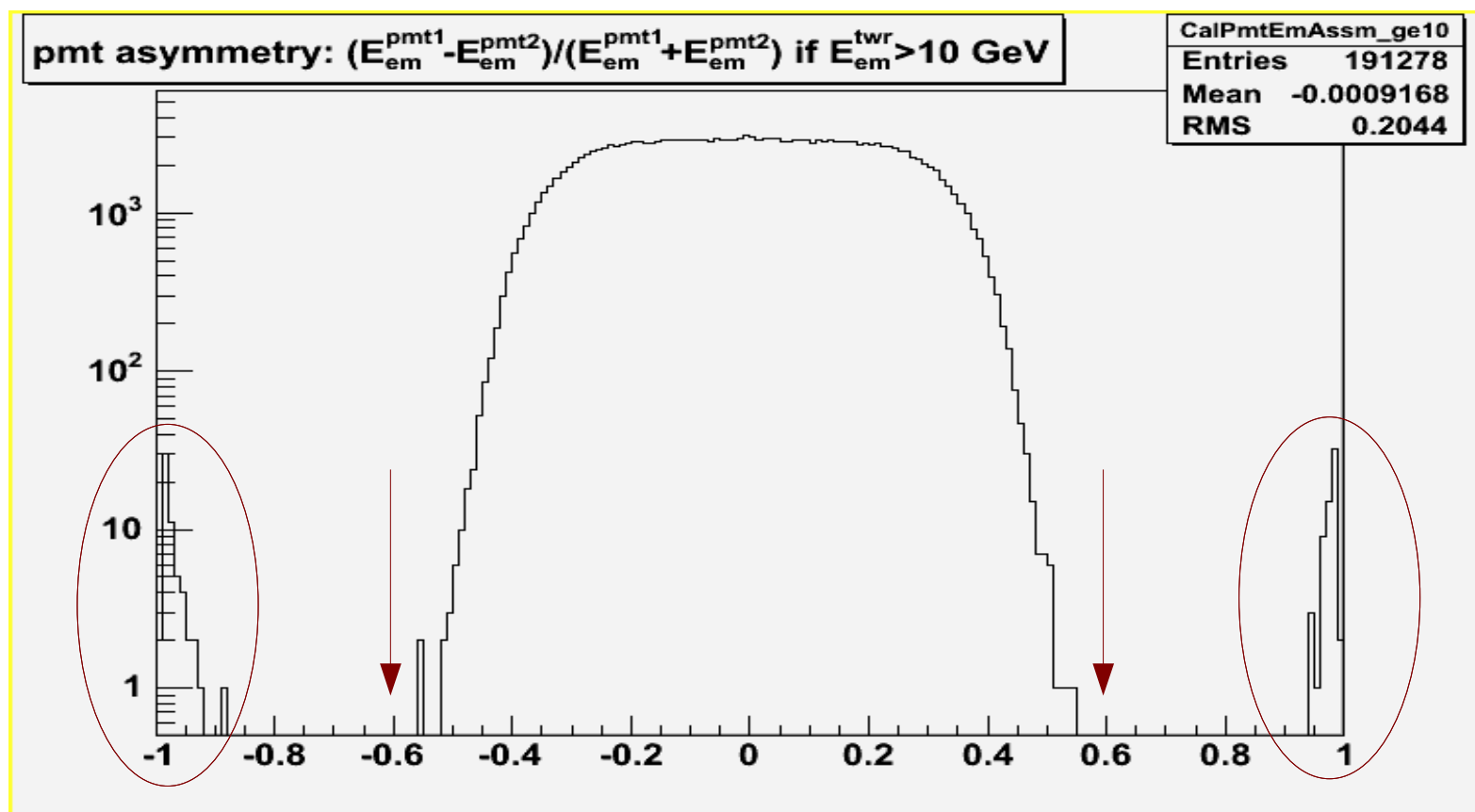
Réjection

Backgrounds:Non-collision: Beam halo

- Use topological cuts (cdfnote:8409)

Increase rejection power →

Halo Type	Selection Cut
0	seedWedge > 8 || Nhad > 1
1	seedWedge > 4 & Nhad > 1
2	seedWedge > 4 & Nhad > 2
3	seedWedge > 7 & Nhad > 2
4	seedWedge > 8 & Nhad > 2
5	seedWedge > 8 & Nhad > 3

Increase efficiency →

→seedWedge = number of EM towers (Et>0.1 GeV) in same wedge as photon
→Nhad = number of plug HAD towers (Et>0.1 GeV) in same wedge as photon

Réjection

Backgrounds:Non-collision: **Beam halo**

SAMPLE PLOTS
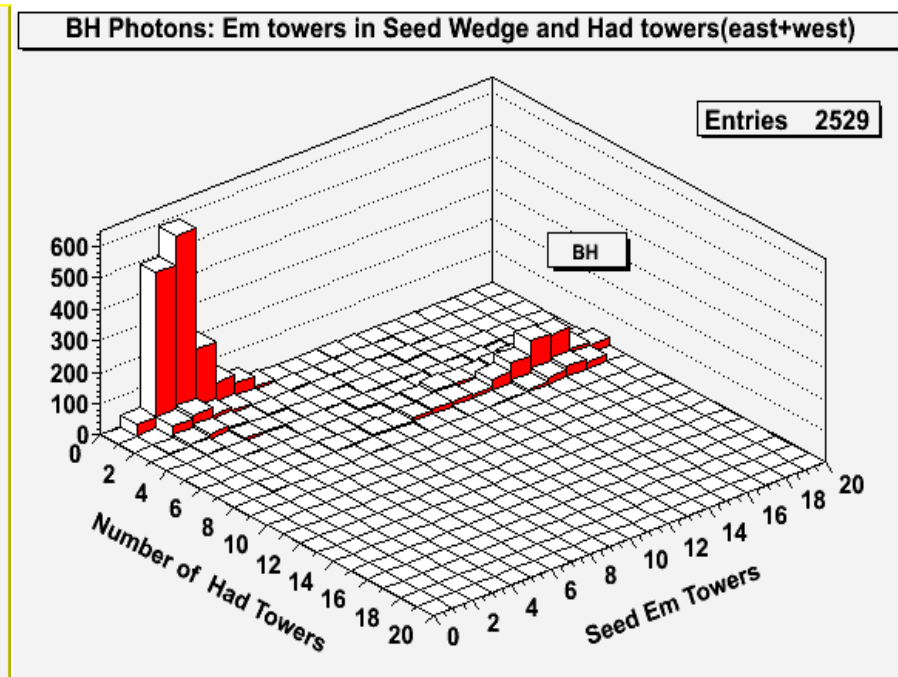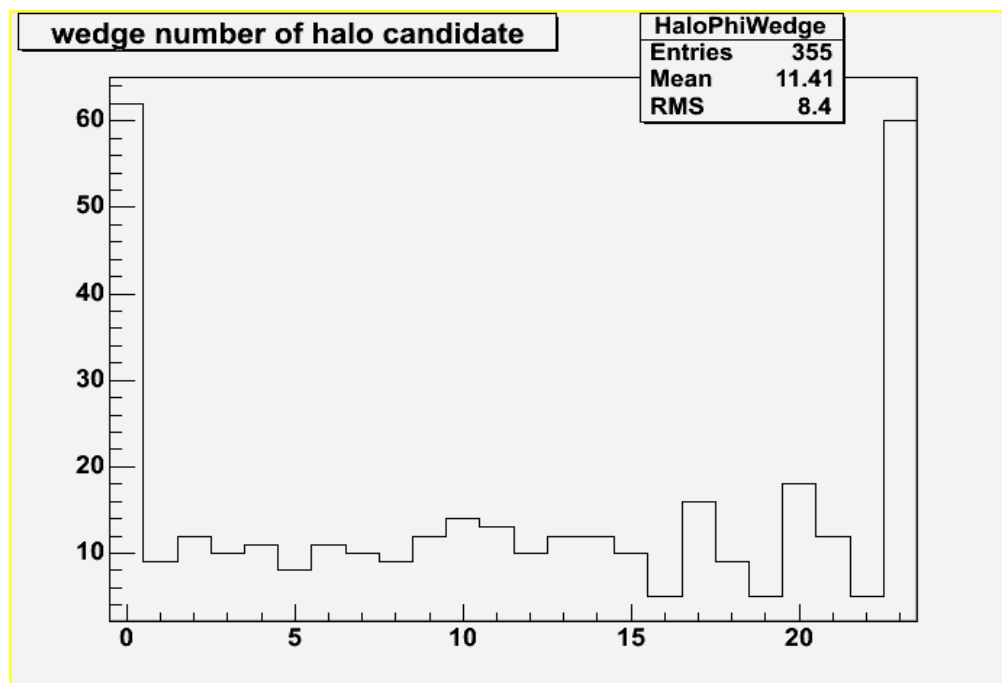
Halos from no vertex events.

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Backgrounds:Non-collision: # Beam halo

- use electrons to measure mis-id rates and to estimate the remainder.
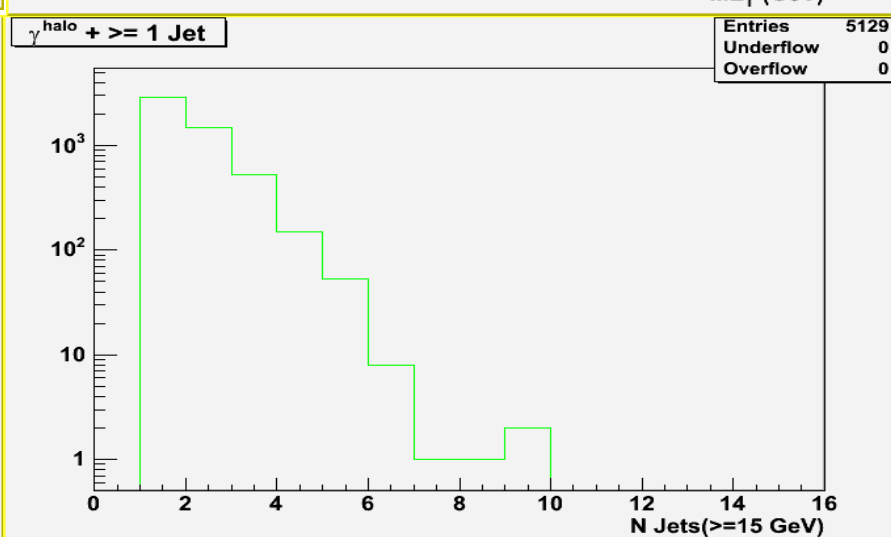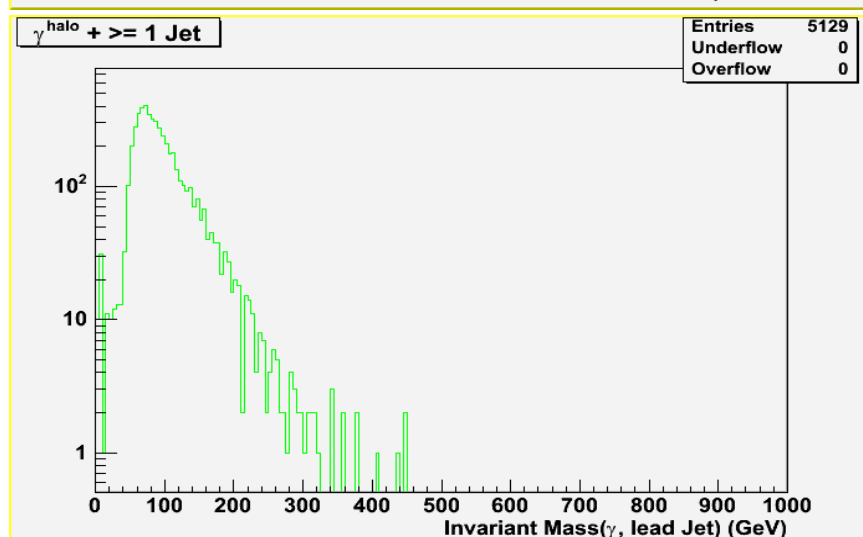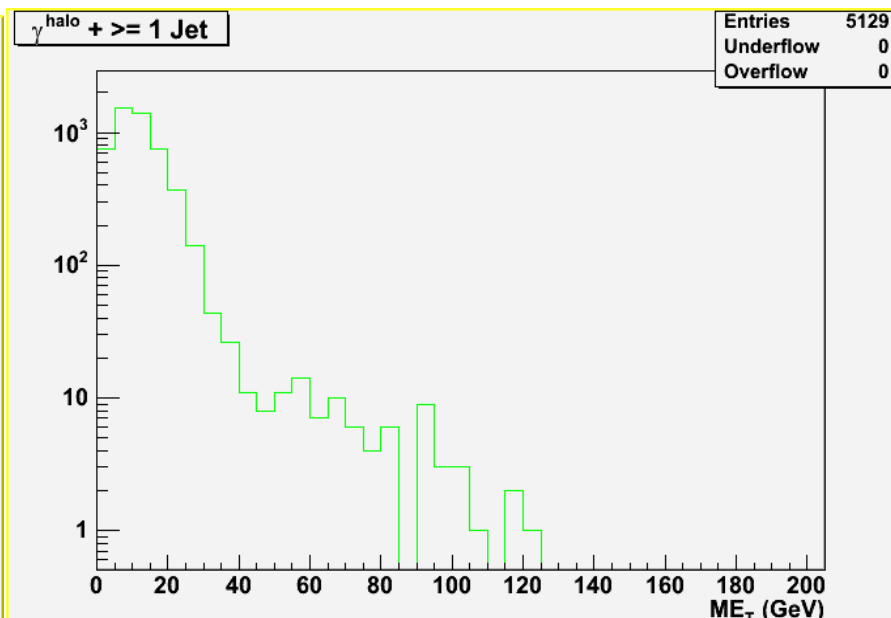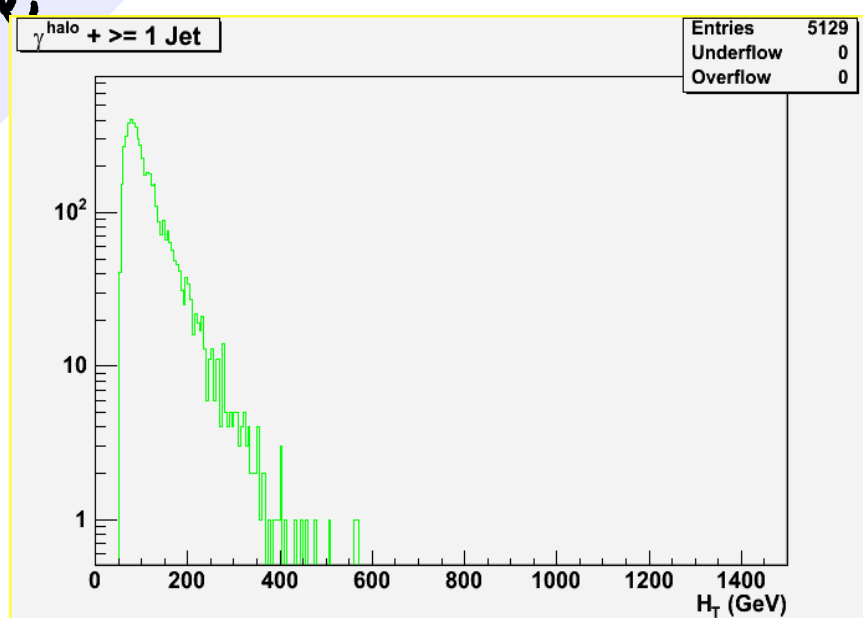
  - use photon-like electron ID cuts and e + Jet events

Halo Type	Mis-ID rates
0	68%
1	55%
2	16%
3	6.5%
4	4.1%
5	1.2%

Expect 3065 events!

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Backgrounds:Non-collision: Beam halo
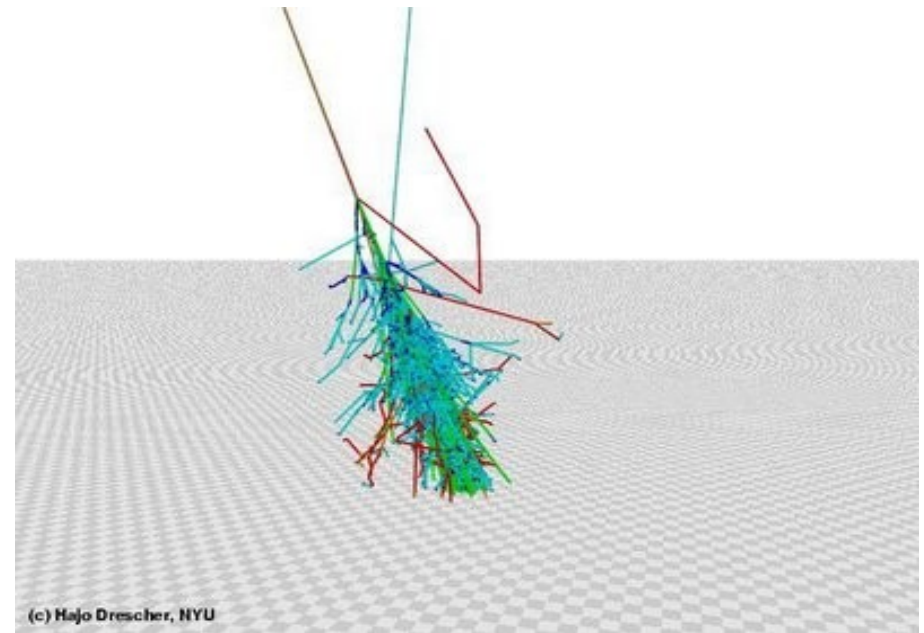
- start with a tight photon
- in-time (> - 4.8ns & < 4.8ns)
- select beam halo using halo cuts (type 5)
- 1 or more Jets

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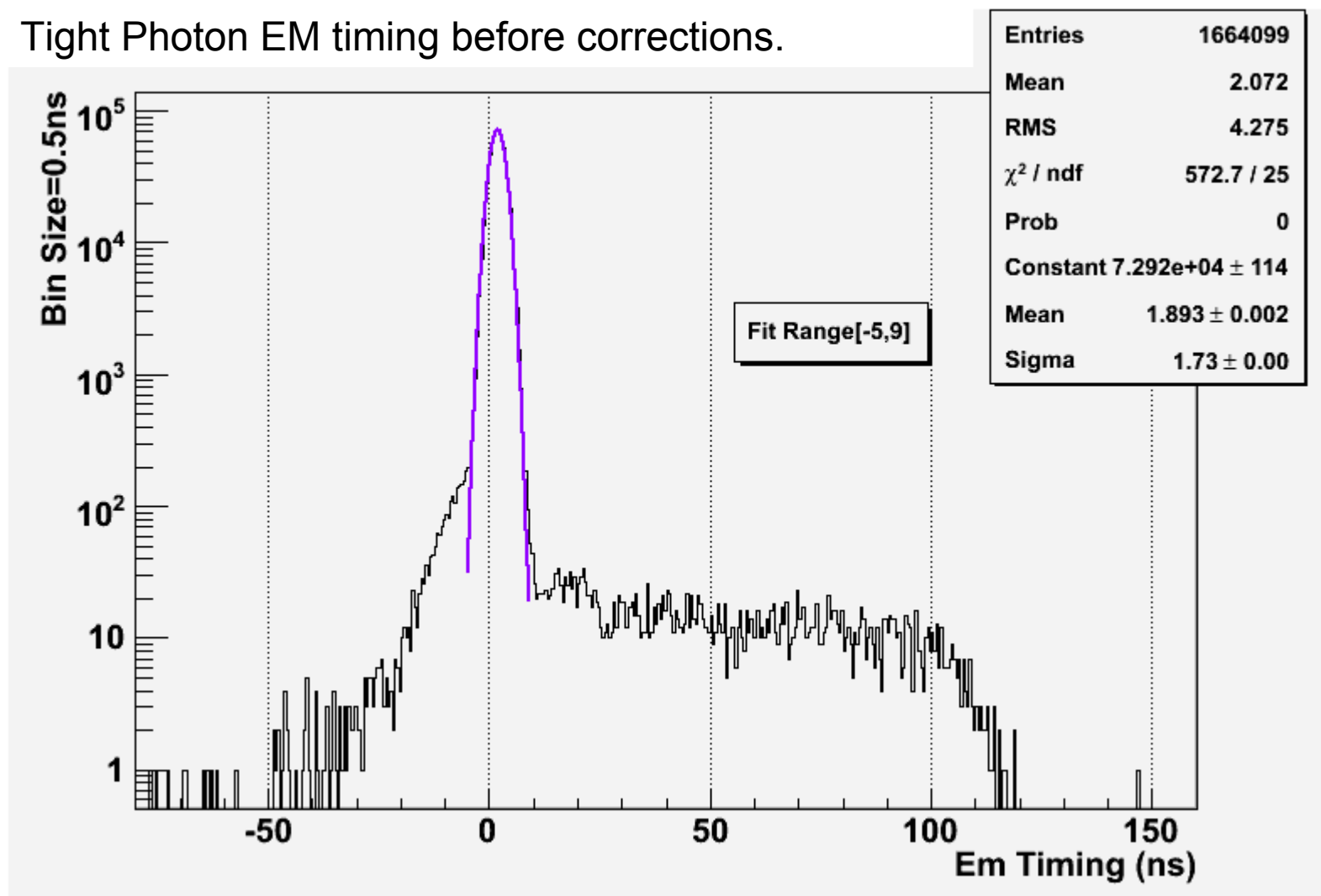# Backgrounds:Non-collision: Beam halo

Réjection

Backgrounds:Non-collision: Cosmic

- Use EM timing

  - require photon to be in-time (>-4.8ns & <4.8ns) for events after 1st 400 pb^{-1}.

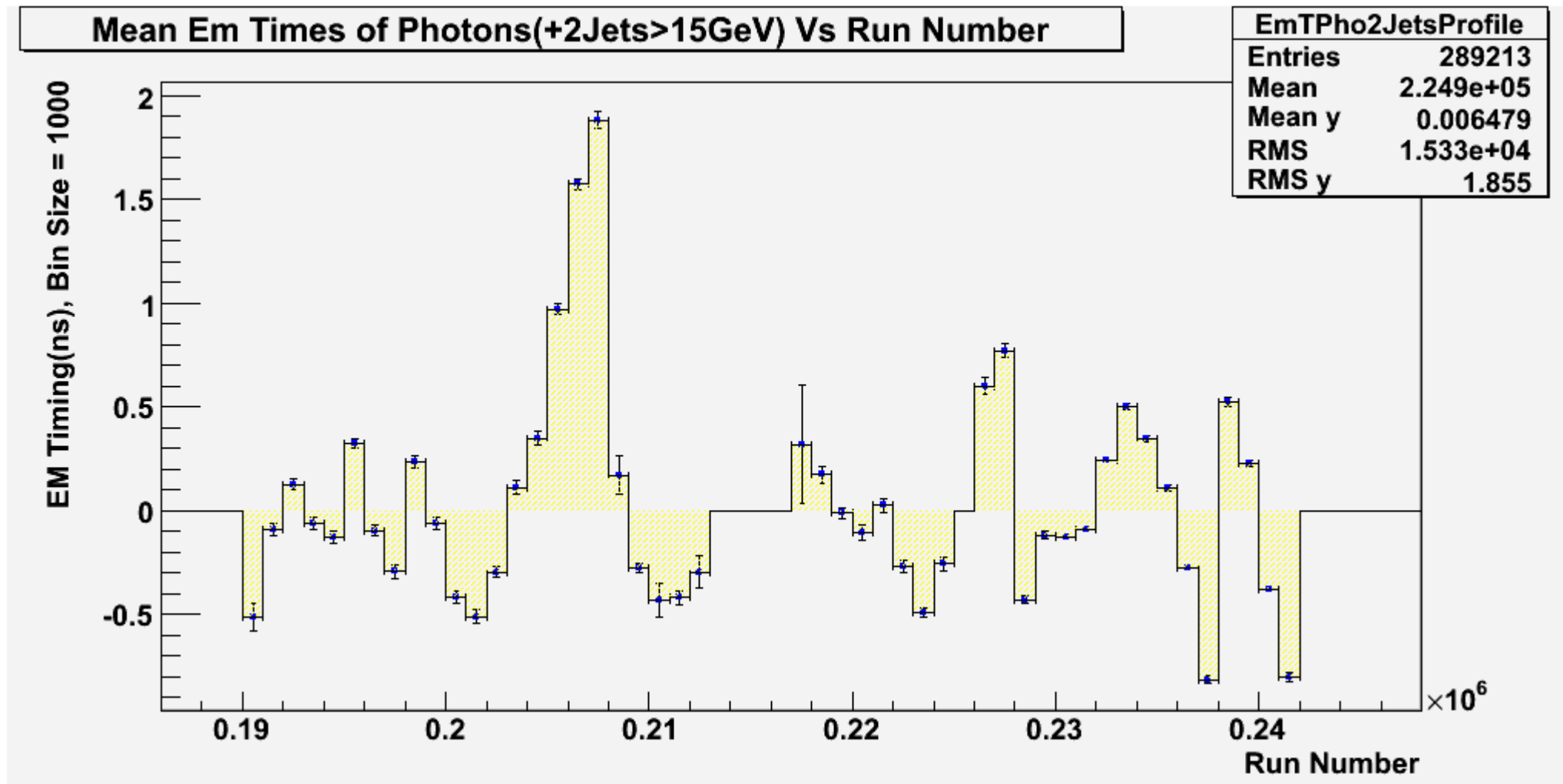- Veto all event with trackless muon stubs in first 400 pb^{-1}.

(c) Hajo Drescher, NYU

Sources:SLAC Virtual Visitor Center, Hajo Drescher

Backgrounds:Non-collision: Cosmic

Tight Photon EM timing before corrections.

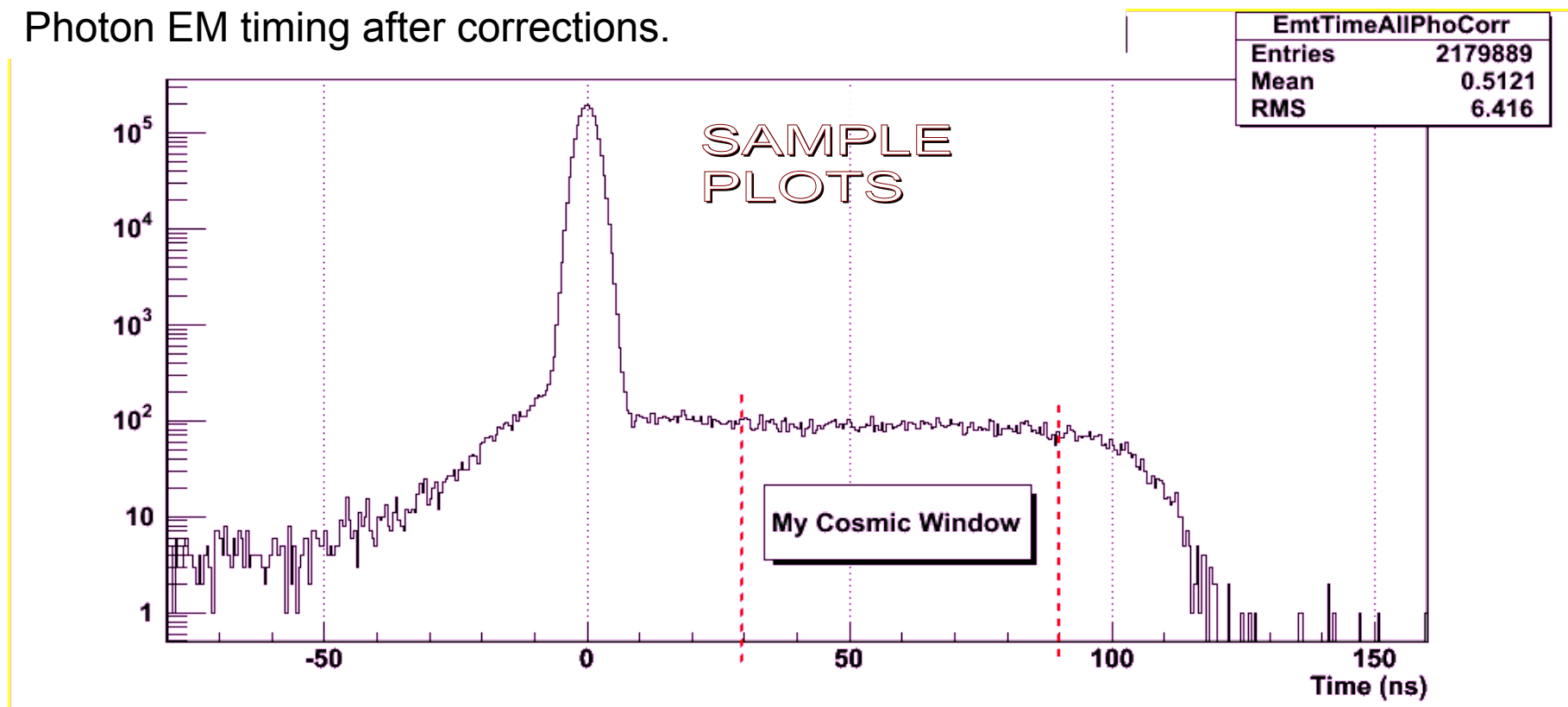| Entries	1664099
Mean	2.072
RMS	4.275
χ^2 / ndf	572.7 / 25
Prob	0
Constant	7.292e+04 ± 114
Mean	1.893 ± 0.002
Sigma	1.73 ± 0.00

Fit Range[-5,9]

Backgrounds:Non-collision: Cosmic

Got corrections to EM timing thanx to Max.

Backgrounds:Non-collision: Cosmic

Photon EM timing after corrections.

Estimation

Backgrounds:Non-collision: Cosmic

+ Pick time window >30ns and < 90ns

+ Count how many has trackless muon stubs.
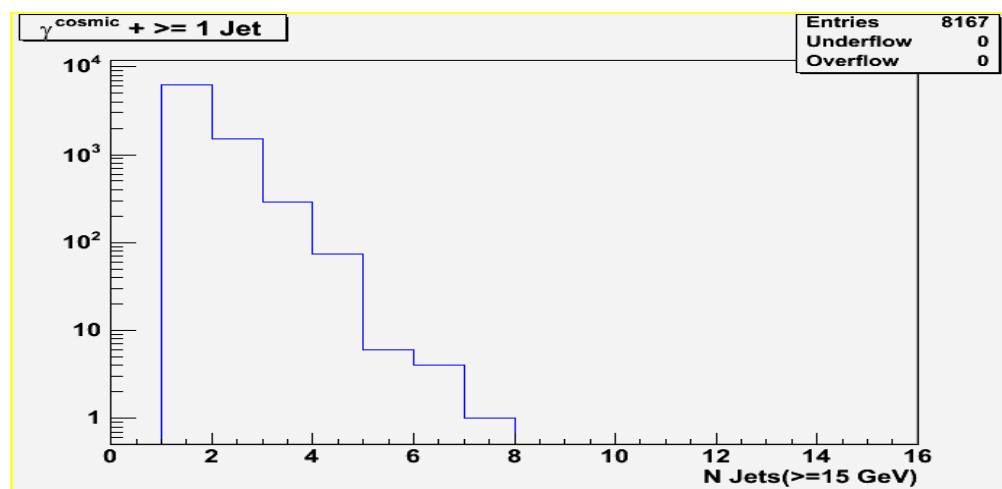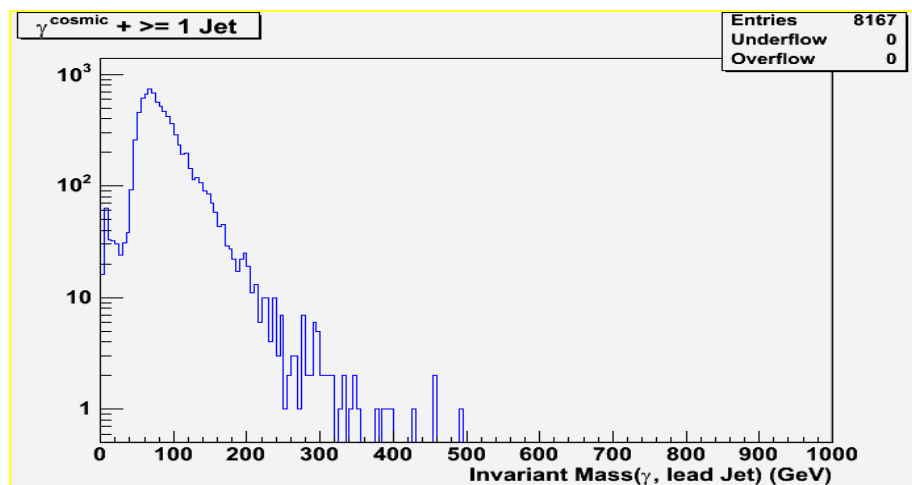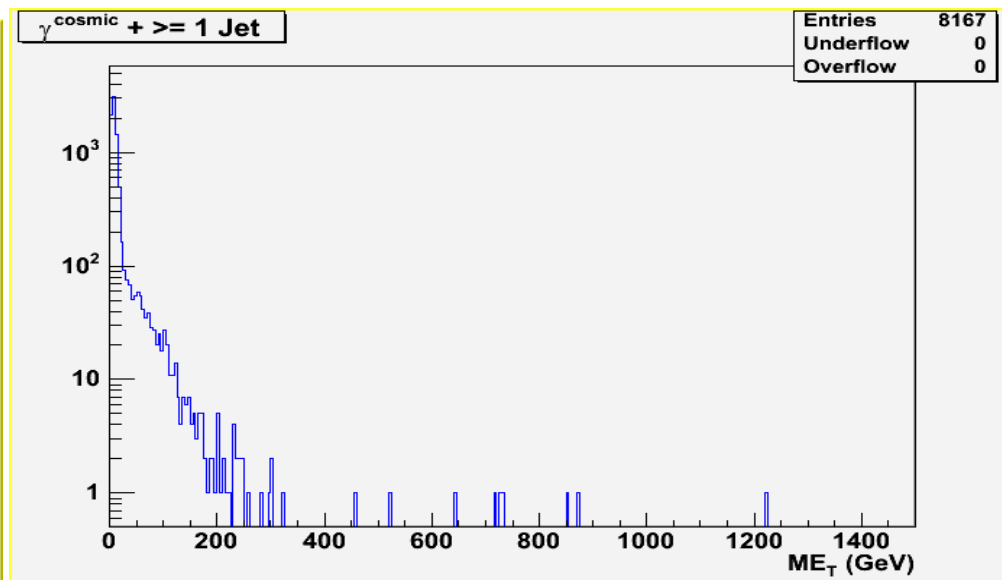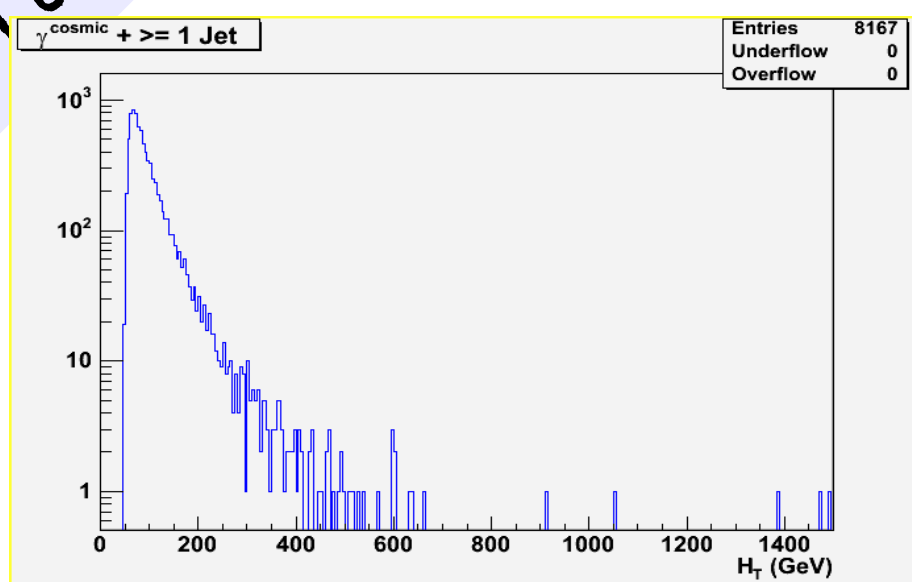
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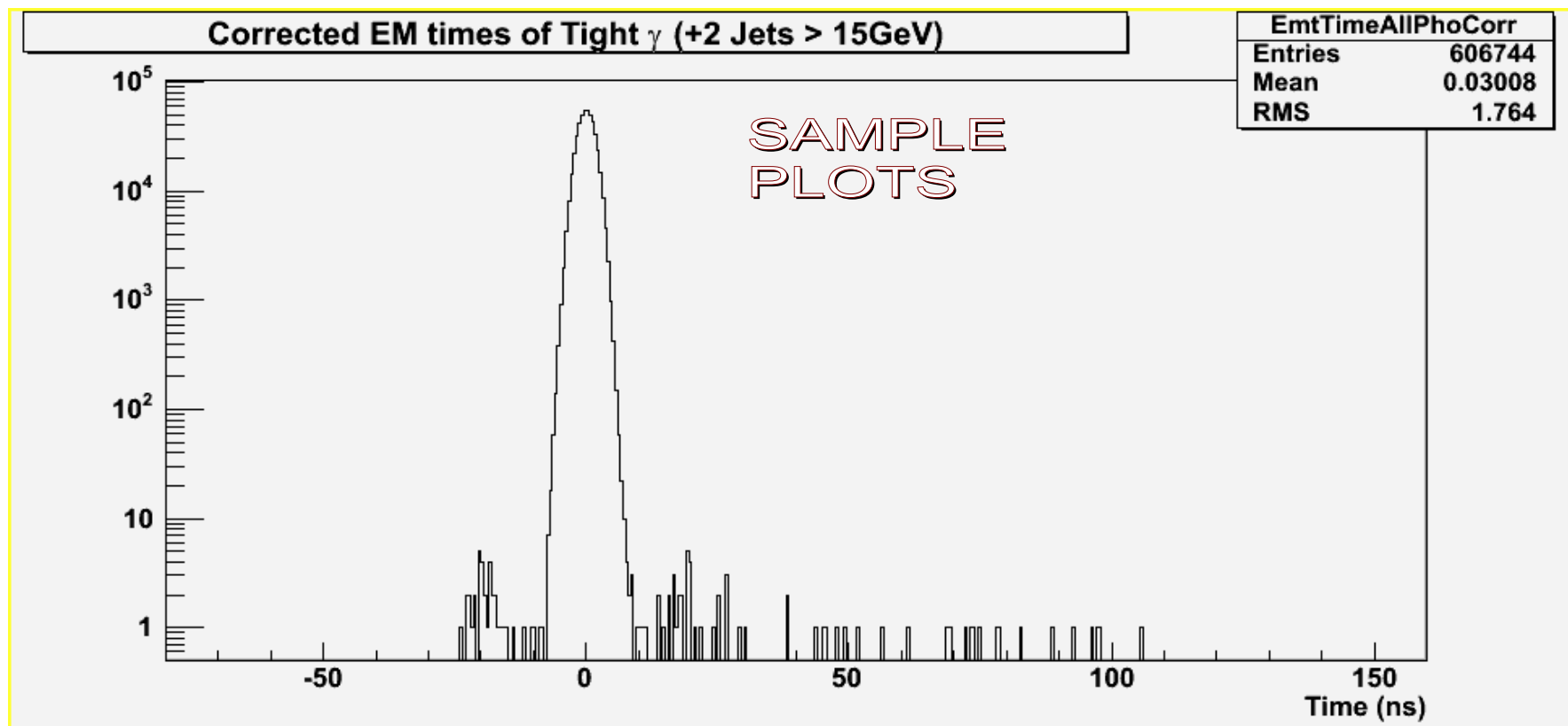
Backgrounds:Non-collision: Cosmic

- Expect 5 events for the period with timing.
- 23 events in first 400 pb^{-1}.

Backgrounds:Non-collision: Cosmic

- Tight photon

- Time between >30ns and < 90ns

- Exclude first 400pb^{-1}

- 1 or more Jets

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Backgrounds:Non-collision: Cosmic

Réjection

Backgrounds:SM Processes: Electron

➜ Use Phoenix rejection (~60% eff. Et>35GeV)

Backgrounds:SM Processes: Electron

Variable	Cut value
detector	central
conversion	no
corrected E_T	> 30 GeV
CES fiduciality	$\|X_{CES}\| \leq 21$ cm 9 cm $\leq \|Z_{CES}\| \leq 230$ cm
average CES χ^2	≤ 20
Had/Em	$\leq 0.055 + 0.00045 \times E$
$E_T^{Iso(corr)}$ in cone 0.4	$\leq 0.1 \times E_T$ if $E_T < 20$ GeV $\leq 2.0 + 0.02 \times (E_T - 20)$ if $E_T \geq 20$ GeV
N3D tracks in cluster	$= 1, 2$
E/p of 1st track	$0.8 \leq E/p \leq 1.2$ if $p_T < 50$ GeV no cut if $p_T \geq 50$ GeV
2nd track p_T if N3D $= 2$	$\leq 1.0 + 0.005 \times E_T$
TrkIso(0.4) - p_T 1^{st}trk	$\leq 2.0 + 0.005 \times E_T$
E_T of 2nd CES cluster (wire and strip)	$\leq 0.14 \times E_T$ if $E_T < 18$ GeV $\leq 2.4 + 0.01 \times E_T$ if $E_T \geq 18$ GeV
$\|\Delta z\| = z_{vtx} - z_{trk}$	≤ 3 cm

Photon-like electron ID cuts

Estimation

Backgrounds:SM Processes: Electron

- Using photon-like electron ID cuts to identify electrons and use fake rate function (cdfnote 8220 -Sasha Pronko et.al.)

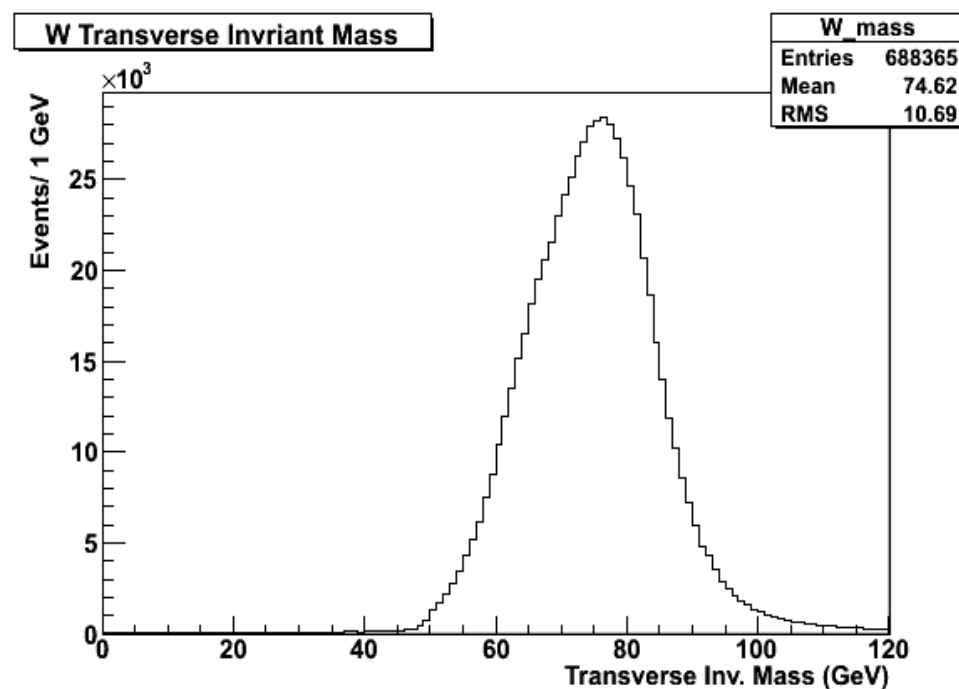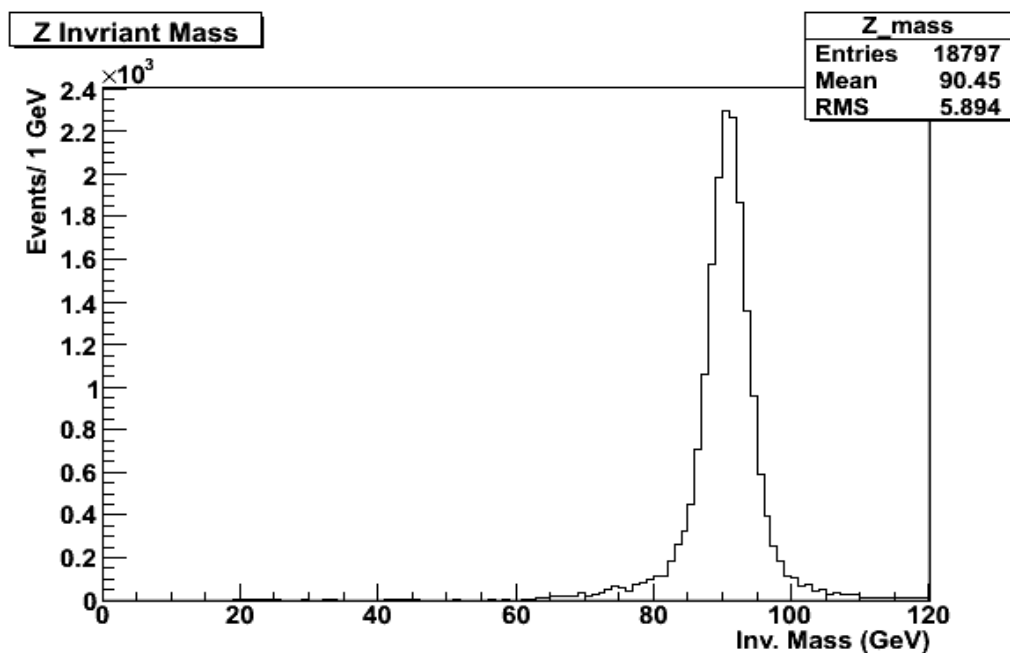- Expect 1281+/-147+/-4

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Backgrounds:SM Processes: Electron

- electron passing photon-like electron ID cuts

- in-time

- not a conversion electron

- use fake rate

- 1 or more Jets

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Backgrounds:SM Processes: Electron
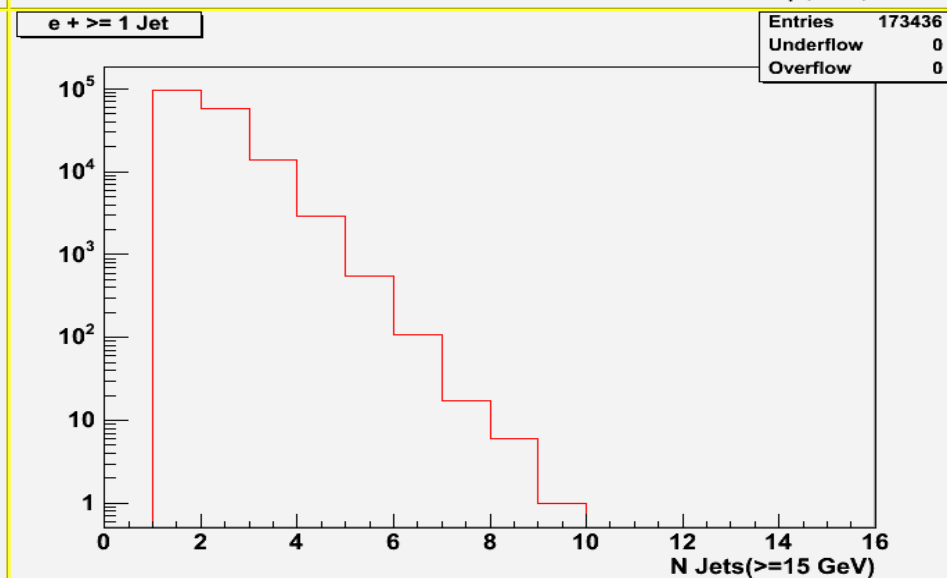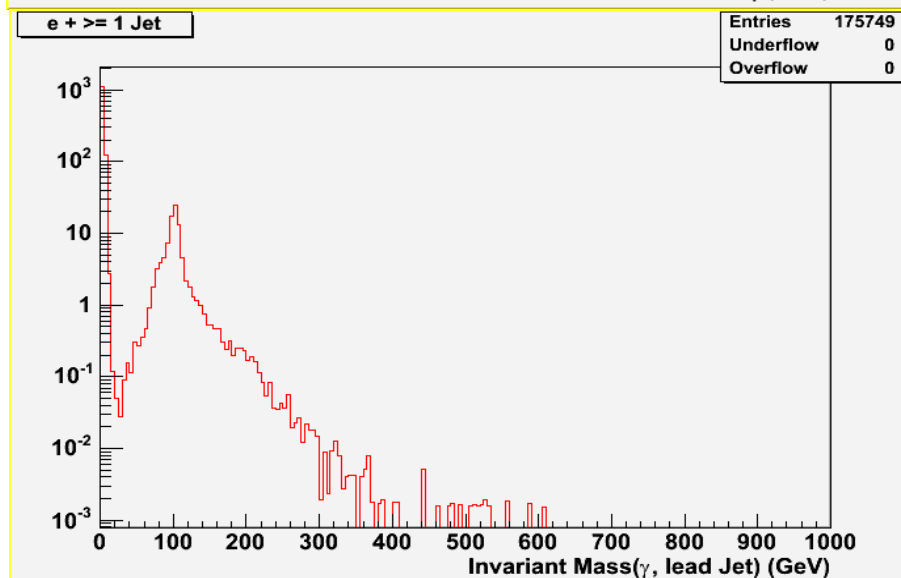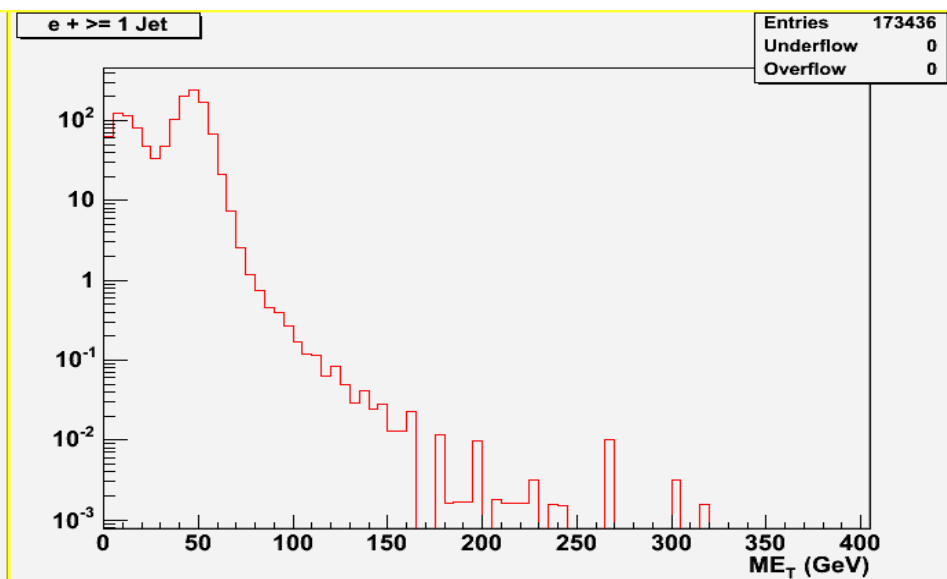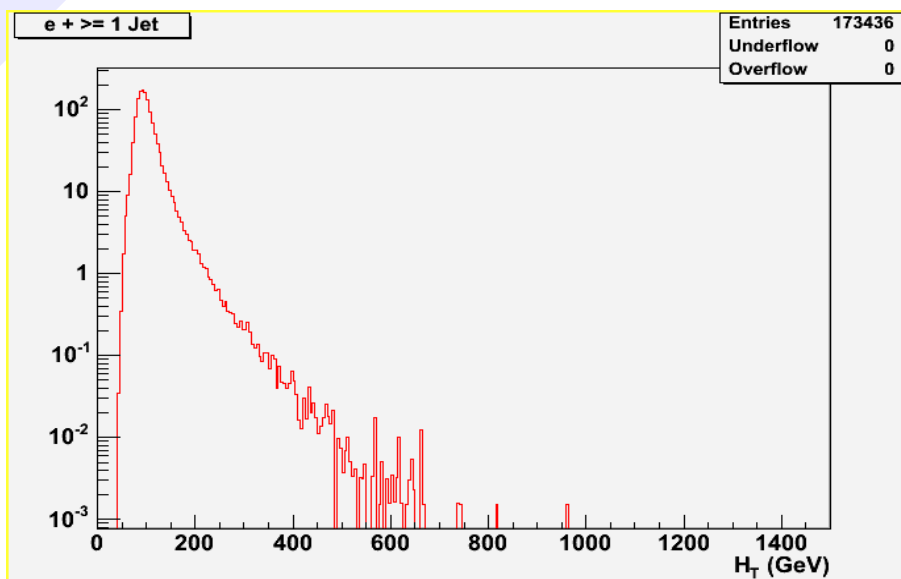
Cross checks

Backgrounds:SM Processes: # Electron

➜ W cross section = 3052 pb^{-1} (2782 pb^{-1} - cdfnote-6939)

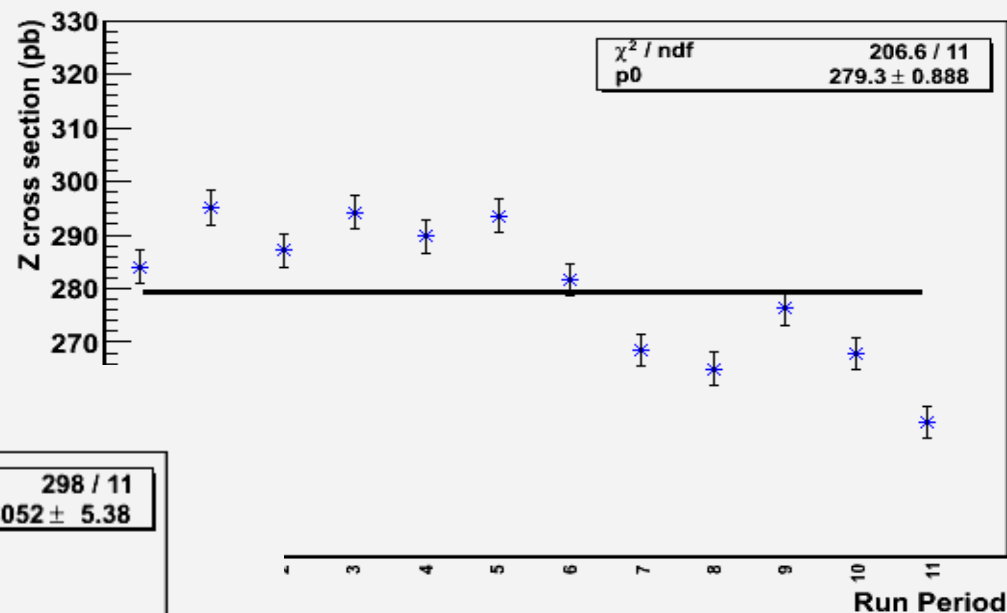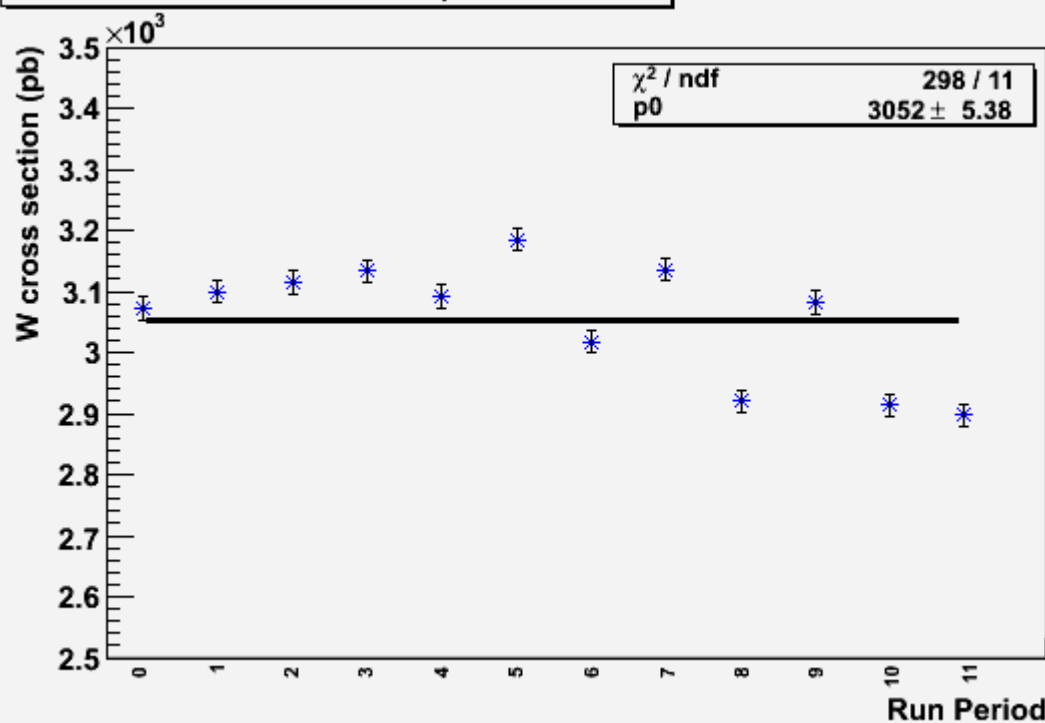➜ Z cross section = 279.3 pb^{-1} (255.2 pb^{-1} - cdfnote-6939)

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Backgrounds:SM Processes: Electron

Summary of Backgrounds

	Expected
	for >=1 Jets
Cosmic	23
Beam halo	3065
Electron	1281+/-147 +/- 4

Thank you.

- Special thanks to Karen (Baylor) for writing down the correction during my practice talk.